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**HOW PLANTS PREPARE FOR WINTER**

(Adapted from <http://www.sciencemadesimple.com/leaves.html>)

All summer, with the long hours of sunlight and a good supply of liquid water, plants are busy making and storing food, and growing. But what about wintertime? The days are much shorter, and water is hard to get. Plants have found many different ways to get through the harsh days of winter.

As plants grow, they shed older leaves and grow new ones. This is important because the leaves become damaged over time by insects, disease and weather. The shedding and replacement continues all the time. In addition, deciduous trees, like maples, oaks and elms, shed all their leaves in the fall in preparation for winter.

During summer days, leaves make more glucose than the plant needs for energy and growth. The excess is turned into starch and stored until needed. As the daylight gets shorter in the autumn, plants begin to shut down their food production.

Many changes occur in the leaves of deciduous trees before they finally fall from the branch. The leaf has actually been preparing for autumn since it started to grow in the spring. At the base of each leaf is a special layer of cells called the "abscission" or separation layer. All summer, small tubes which pass through this layer carry water into the leaf, and food back to the tree. In the fall, the cells of the abscission layer begin to swell and form a cork-like material, reducing and finally cutting off flow between leaf and tree. Glucose and waste products are trapped in the leaf. Without fresh water to renew it, chlorophyll begins to disappear.

Other colors, which have been there all along, become visible when the chlorophyll disappears. The orange colors come from carotene ('kar-uh-teen) and the yellows from xanthophyll ('zan-thuh-fil). They are common pigments, also found in flowers, and foods like carrots, bananas and egg yolks. Carotenes and xanthophylls absorb wavelengths of light that chlorophyll doesn’t. Different combinations of these pigments give us a wide range of colors each fall. Brown fall foliage colors come from tannin, a bitter waste product.

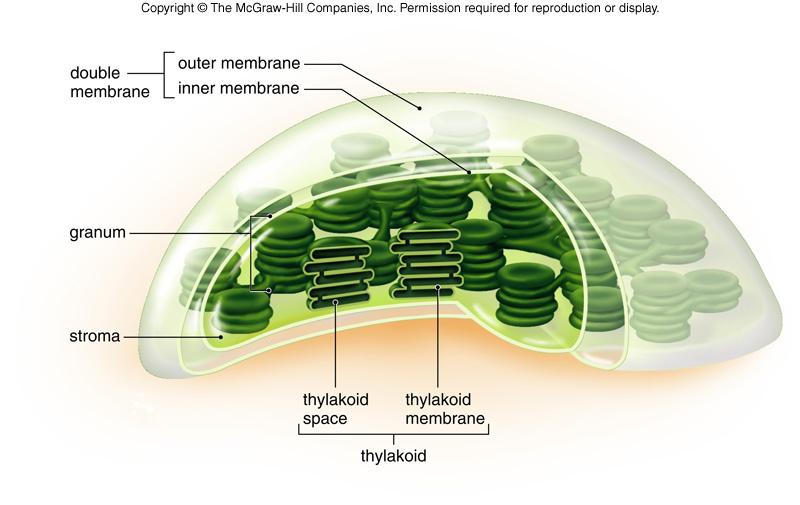
The bright red and purple fall foliage colors come from anthocyanin (an-thuh-'si-uh-nuhn) pigments, which are not used in photosynthesis. These are potent antioxidants common in many plants; for example, beets, red apples, purple grapes (and red wine), and flowers like violets and hyacinths. In some leaves, like maple leaves, these pigments are formed in the autumn from trapped glucose. Why would a plant use energy to make these red pigments, when the leaves will soon fall off? Some scientists think that the anthocyanins help the trees keep their leaves a bit longer. The pigments protect the leaves from the sun, and lower their freezing point, giving some frost protection. The leaves remain on the tree longer, and more of the sugars, nitrogen and other valuable substances can be removed before the leaves fall. Another possible reason has been proposed: when the leaves decay, the anthocyanins seep into the ground and prevent other plant species from growing in the spring.

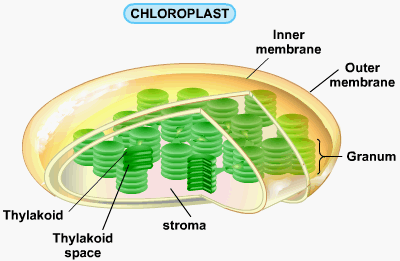
As the bottom cells in the separation layer form a seal between leaf and tree, the cells in the top of the separation layer begin to disintegrate. They form a tear-line, and eventually the leaf is blown away or simply falls from the tree.

1. Why deciduous plants make more glucose than is necessary at the time of production?
2. Why does chlorophyll break down?
3. Why do pigments such as carotene and xanthophyll produce colors other than green?
4. What are two reason scientists think plants produce anthocyanins?

Chloroplast Labeling

Directions: Use the upper image to label the lower image. Then answer the questions below.





1. What structure(s) of the chloroplast support the endosymbiotic theory?

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